

Claims

Cancel all claims of record and substitute amended claim 1-5, 10- 26; withdrawn claim 7; original claim 9; and new claim 27, as follows:

1. (currently amended): Apparatus for the collection and focusing of gas-phase ions ~~and/or~~ or particles at or near atmospheric pressure, the apparatus comprising:
 - a. a dispersive source of ions;
 - b. a conductive high transmission surface populated with a plurality of holes through which said ions pass unobstructed on the way to a collector target, aperture, or tube; said high transmission surface having a topside and an underside, the said high transmission surface being supplied with an attracting electric potential by connection to a voltage supply, and generating an electrostatic field between the said source of ions and the top side said topside of the said high transmission surface; the said high transmission surface also being shaped to affect high focusing fields on the focusing side, underside, of the said high transmission surface, whereby said electrostatic field at said underside of said high transmission surface is greater than said electrostatic field at said topside of said high transmission surface;
 - c. a target surface for receiving ions or transmitting focused ions through opening of target apertures, or tubes aperture, or tube in said target surface; said target surface held at a second ion-attracting and higher strength electric potential by connection to ~~the~~ said voltage supply, and generating an electrostatic field between the said underside of said high transmission surface and the orifice said opening of said target aperture or tube which has electrostatic field lines that are concentrated on a relatively small reduced cross-sectional area of said target surface, said opening of said target aperture, or opening of said tube opening;
 - d. an inner field-shaping electrode for focusing ions exiting the underside of said high transmission surface whereby approximately all said ions are focused toward said small reduced cross-sectional area on the said target surface.
2. (currently amended): Apparatus as in claim 1 wherein ~~the~~ said target surface comprises a conductive end of a capillary tube, wherein said capillary tube is the atmospheric or near

3 atmospheric pressure inlet to the vacuum chamber of a mass spectrometer.

1 3. (currently amended): The apparatus of claim 1 wherein said inner field-shaping electrode is
2 a metal electrode whereby said ~~electric~~ electrostatic potential from said target surface
3 penetrates into ~~the~~ a focusing region between the ~~backside~~ underside of said high
4 transmission surface and said metal electrode through a single central aperture in said metal
5 electrode.

1 4. (currently amended): The apparatus of claim 1 wherein said inner field-shaping electrode is
2 a metal electrode held at the same potential as ~~the~~ said high transmission surface.

1 5. (currently amended): The apparatus as in claim 1 further including an analytical apparatus
2 in communication with ~~the~~ said target ~~surface~~ aperture or tube in said target surface,
3 wherein ~~the~~ said aperture or tube is interposed between the underside of said ~~target~~ high
4 transmission surface and ~~the~~ said analytical apparatus, said ~~small~~ reduced cross-sectional
5 area of ions being directed through ~~the~~ said opening of said target aperture or tube into said
6 analytical apparatus.

1 6. (currently amended): Apparatus as in claim 5 wherein said analytical apparatus
2 comprises a mass spectrometer or ion mobility spectrometer or combination thereof.

1 ~~(cancelled)~~
2 7. (withdrawn): Apparatus as in claim 5 wherein said analytical apparatus comprises an
3 ion mobility spectrometer.

1 8. (currently amended): Apparatus as in claim 1 wherein said gas-phase ions are formed by
2 means of an atmospheric or near atmospheric ionization ~~sources such as, electrospray,~~
3 ~~atmospheric pressure chemical ionization, atmospheric laser desorption, photoionization,~~
4 ~~discharge ionization, inductively coupled plasma ionization.~~ ; electrospray, atmospheric
5 pressure chemical ionization, laser desorption, photoionization, or discharge ionization
6 sources; or inductively coupled plasma ionization source, or a combination thereof.

1 9. (original): Apparatus of claim 8 wherein said atmospheric or near atmospheric
2 ionization source is made up of a plurality of said atmospheric or near atmospheric ion
3 sources operated simultaneously or sequentially.

1 10. (currently amended): Apparatus of claim 1, wherein said target surface, is made up of a
2 plurality of said focal points resulting from mechanical ~~variation~~ variations of said inner
3 field-shaping ~~electrode~~ electrode's position and shape. ~~Ions and shape~~, ions or charged
4 particles collected at the said focal points, being accumulated onto the said target surface
5 for collection or passed through said opening in said target ~~apertures~~ aperture and or tubes
6 tube for analysis.

1 11. (currently amended): Apparatus in claim 1 further including a pure gas supplied ~~in such a~~
2 ~~way~~ between the said target surface and said inner field-shaping electrode, or between the
3 said inner field-shaping electrode and the said high transmission surface, whereby
4 substantially all said gas flows into the said focusing region between said inner field
5 shaping electrode and said high-transmission surface and through the said plurality of
6 holes in said high transmission surface.

1 12. (currently amended): An apparatus in claim 1 further including an outer field-shaping
2 electrode surrounding the circumference of the said high transmission surface; said outer
3 field-shaping electrode held at a potential the same or slightly above the potential on the
4 said high transmission surface, said outer field-shaping electrode functioning to shield the
5 ~~outer surface~~ topside of the said high transmission surface from high electrostatic fields
6 found in some needle containing source regions that suppress said electrostatic field
7 penetration from the said focusing region ~~potentials~~ into the said ion source region.

1 13. (currently amended): Apparatus for the collection and focusing of an aerosol of gas-phase
2 charged ~~parties~~ ~~or droplets~~ or particles at or near atmospheric pressure, the apparatus
3 comprising:

4 a. a source of charged droplets or particles;

5 b. a conductive high transmission surface with a plurality of holes through which said aerosol of
6 charged droplets pass unobstructed on the way to a target surface, said high transmission
7 surface having a topside and an underside, the said high transmission surface being supplied
8 with an attracting ~~electric~~ electrostatic potential by connection to a voltage supply, and
9 generating an electrostatic field between the said source of charged droplets, from an said

10 atmospheric ionization source, and ~~the top-side~~ said topside of said high transmission surface,
11 whereby said electrostatic field at said underside of said high transmission surface is greater
12 than said electrostatic field at said topside of said high transmission surface;

13 c. a target surface for receiving ~~droplets~~ said charged particles, the said target surface being
14 supplied with a second ion-attracting and higher strength ~~electrical~~ electrostatic potential by
15 connection to the said voltage supply, and generating an electrostatic field between the said
16 underside of said high transmission surface and ~~the target~~ said target surface whereby ~~electric~~
17 electrostatic field lines are concentrated to a ~~small~~ reduced cross-sectional area on the said
18 target surface;

19 d. an inner field-shaping electrode for focusing said charged particles exiting the said underside
20 of said high transmission surface whereby approximately all said charged droplets are focused
21 onto said target surface.

1 14. (currently amended): The apparatus of claim 13 wherein said inner field-shaping electrode is
2 a metal electrode whereby said ~~electric~~ electrostatic field from said target surface penetrates
3 into a focusing region between ~~the backside~~ said underside of said high transmission surface
4 and said inner field-shaping electrode through a central aperture in the said inner field-
5 shaping electrode.

1 15. (currently amended): The apparatus of claim 13 wherein ~~the~~ said charged droplets and or
2 particles are formed by means of atmospheric or near atmospheric pressure ionization
3 ~~sources, such as, electrospray, discharge ionization, electron capture ionization, and inductive~~
4 ~~charging; ; electrospray, atmospheric inductive charging, discharge, or electron capture~~
5 ionization; or combination thereof.

1 16. (currently amended): The apparatus of claim 15 wherein ~~the~~ said atmospheric or near
2 atmospheric ionization source is made up of a plurality of sources.

1 17. (currently amended): The apparatus of claim 13 wherein ~~the~~ said target surface is made up of
2 a plurality of targets whereby position and time dependence of focal points of said
3 electrostatic field lines are determined by variation in the geometry, position, and potential of

4 said inner field-shaping electrode geometry, position and potential.

1 18. (currently amended): A Method for the transfer of charged particles ~~and/or~~ or ions from a highly
2 dispersive area or source at or near atmospheric pressure and focusing approximately all said
3 charged particles ~~and~~ or ions into an inlet aperture for gas-phase ion analysis, the method
4 comprising:

5 a. providing ~~electrical~~ electrostatic attraction to ~~ions and~~ said charged particles or ions with
6 electrostatic fields provided by a perforated high transmission surface, ~~the said perforated high~~
7 transmission surface having an ion drawing potential, such that electrostatic field lines
8 between the said source of gas-phase ~~ions or~~ charged particles or ions ~~partiele~~ and said
9 perforated high transmission surface are concentrated on the topside ~~top-side~~ of said perforated
10 high transmission surface;

11 b. transmitting said charged particles or ions through said perforated high transmission surface
12 by allowing the unobstructed passage into a focusing region by providing a plurality of holes
13 in said perforated high transmission surface with low depth aspect ratio, a high openness
14 aspect ratio, and a ~~high electrical~~ electrostatic potential ratio greater than one, between the
15 ~~backside underside~~ underside and said topside of said perforated high transmission surface ~~and a target~~
16 ~~surface~~, and;

17 c. providing electrostatic attraction to said charged particles or ions in the said focusing region
18 with a second electrostatic field generated by said a target surface, ~~the said~~ said target surface
19 having an ion-drawing potential such that electrostatic field lines between the ~~backside~~ said
20 underside of said perforated high transmission surface and said inlet aperture in said target
21 surface are concentrated onto the said target surface urging approximately all ~~ions or~~ said
22 charged particles or ions in said focusing region to be directed towards said target surface
23 whereby approximately all ~~ions and~~ said charged particles or ions flow into said inlet aperture
24 as a small reduced cross-sectional area.

1 19. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles or ions from said highly dispersive sources source at or near atmospheric pressure
3 for gas-phase ion analysis, comprises said inlet aperture at the a focal point of ~~the focal region~~

4 of said reduced cross-sectional area so that a substantial fraction of ~~ions or particles~~ said
5 charged particles or ions are transmitted to ~~an analytical system such as~~ a mass spectrometer
6 or ion mobility spectrometer or a combination thereof.

1 20. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles or ions from said highly dispersive ~~sources~~ source at or near atmospheric pressure
3 for gas-phase ion analysis, comprises a means of additional electrostatic focusing to said
4 charged particles or ions in the said focusing region, ~~the~~ said additional focusing having an
5 ion-drawing potential such that said electrostatic field lines are primarily concentrated on said
6 inlet aperture whereby approximately all said charged particles or ions are urged into an
7 ~~aperture~~ said inlet aperture ~~on~~ in said target surface.

1 21. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles ~~or ions~~ from said highly dispersive ~~sources~~ source at or near atmospheric pressure
3 for gas-phase ion analysis, ~~comprises an~~ said inlet aperture is an inlet aperture of an
4 atmospheric pressure interface of a mass spectrometer.

1 22. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles ~~or ions~~ from said highly dispersive ~~sources~~ source at or near atmospheric pressure
3 for gas-phase ion analysis, comprises a plurality of focal points on the said target surface.

1 23. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles ~~or ions~~ from said dispersive ~~sources~~ source at or near atmospheric pressure for gas-
3 phase ion analysis, ~~comprises an~~ said inlet aperture is an inlet aperture of an ion mobility
4 spectrometer.

1 24. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles ~~or ions~~ from said dispersive ~~sources~~ source at or near atmospheric pressure for gas-
3 phase ion analysis, comprises a plurality of dispersive sources of said ~~ions or charged~~
4 ~~particles~~ charged particles or ions.

1 25. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles or ions from said highly dispersive source at or near atmospheric pressure for gas-

3 phase ion analysis, said ~~electric~~ electrostatic field ratio at points equidistant from the
4 upstream or said topside and downstream or said underside surface of the said high
5 transmission surface is greater than 10 to 1 with said downstream (focusing side) the focusing
6 side (~~downstream~~) having the greater magnitude.

1 26. (currently amended): Method as in claim 18 further comprising feeding a pure gas in such a
2 way between the said inlet aperture and ~~focusing lens in focusing region~~ said perforated high
3 transmission surface, or between the ~~focusing lens~~ said additional electrostatic means and the
4 said perforated high transmission surface, whereby approximately all said gas passes into the
5 said focusing region and through the said plurality of holes in said perforated high
6 transmission surface preventing larger particles from crossing the ~~surface of the said~~
7 perforated high transmission element surface from the said source region to into the said
8 focusing region.

1 27. (currently amended): Method as in claim 18, wherein providing the transfer of said charged
2 particles or ions from said highly dispersive source at or near atmospheric pressure for gas-
3 phase ion analysis, said ~~electric~~ electrostatic field ratio at points equidistant from the
4 upstream or said topside and downstream or said underside surface of the said high
5 transmission surface is greater than 1 to 1 with said downstream (focusing side) the focusing
6 side (~~downstream~~) having the greater magnitude.